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PATHOGENS FROM ECONOMICALLY IMPORTANT
NITIDULID BEETLES

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PATHOGENS FROM ECONOMICALLY IMPORTANT NITIDULID BEETLES¹

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SUMMARY

One hundred eighteen nitidulid beetle cultures obtained from localities throughout the continental United States, Mexico, and Hawaii were examined for pathogens. An annotated list was compiled to show abundance, distribution, and taxonomic categories of the pathogens found. Of 15 nitidulid species examined, 14 were infected with

protozoans and 5 with nematodes. Four of these pathogens—a sphaerulariid nematode (*Howardula* sp.) and three sporozoans (*Helicosporidium parasiticum* Keilin, *Pleistophora* sp., and a pyriform *Nosema* sp.)—are being studied as possible biological control agents of stored-product insects.

INTRODUCTION

As part of a 3-year (1967–69) taxonomic study of the larval stages of economically important nitidulid beetles, samples of live beetles were collected and established in laboratory cultures. Samples were obtained from many geographic locations in the continental United States,

Mexico, and Hawaii. Cultures from these collections provided a unique opportunity to investigate associated pathogens. An annotated list was compiled to show the abundance, distribution, and taxonomic categories of the pathogens found.

MATERIALS AND METHODS

Nitidulids were reared in quart jars one-third filled with a 1:1 mixture of damp sand and peat moss and provided with two autoclaved figs per week. Before examination, each culture was maintained for at least three generations in the same jar to allow possible pathogens to increase and spread through the culture.

A minimum of eight adult beetles were examined from each accession. Specimens were dissected in a 0.65-percent saline solution under 10 \times magnification, and were subsequently examined under phase contrast at 500 to 1,250 \times .

RESULTS AND DISCUSSION

Most of the pathogens observed in this study are undescribed. Those readily identified were determined to the species level; the rest were grouped under higher categories of classification. Pathogens that the authors deemed as having biological control potential have been maintained for further study. In the following annotated list, the nitidulid hosts, their pathogens, and the collec-

tion localities are cited alphabetically. In each citation, the insect host, locality, date, collector, plant host, and pathogens collected are listed in that order. At least one pathogen was present in 86.4 percent of the nitidulid accessions examined. The remaining 13.6 percent negative accessions were cited to indicate the geographical locations sampled.

¹This study was made at the Stored-Product Insects Research Laboratory, Western Region, Northern California-Nevada Area, USDA, ARS, Fresno, Calif.

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NITIDULIDAE

Carpophilus corticinus (Erichson)

1

Locality: Florida, Gainesville, Alachua County
 Date: April 14, 1967
 Collector: G. M. Buxton and F. W. Mead
 Host: Japanese persimmon
 Diagnosis: Cephaline eugregarine.

Carpophilus dimidiatus (Fabricius)

1

Locality: California, Fresno, Fresno County
 Date: April 3, 1970
 Collector: Laboratory culture
 Host: Cull figs
 Diagnosis: *Farinocystus* sp.

2

Locality: Georgia, Lumpkin, Stewart County
 Date: October 3, 1968, and January 10, 1969
 Collector: J. A. Payne
 Host: Shelled peanuts
 Diagnosis: *Helicosporidium parasiticum* Keilin;
Nosema sp. (ovoid); *Ophryocystis* sp.;
 sphaerulariid nematode.

3

Locality: Georgia, Newton, Baker County
 Date: October 3, 1968
 Collector: J. A. Payne
 Host: Shelled peanuts
 Diagnosis: *Ophryocystis* sp.

4

Locality: Georgia, Tifton, Tift County
 Date: June 3, 1968, and June 26, 1968
 Collector: J. A. Payne
 Host: Fieldcorn and shelled peanuts
 Diagnosis: Cephaline eugregarine; *Helicosporidium*
parasiticum; *Nosema* sp. (ovoid);
Ophryocystis sp.

5

Locality: Georgia, Valdosta, Lowndes County
 Date: June 3, 1968
 Collector: J. A. Payne
 Host: Shelled corn
 Diagnosis: Cephaline eugregarine; *Helicosporidium*
parasiticum; *Ophryocystis* sp.

Carpophilus freemani Dobson

1

Locality: Alabama, Auburn, Lee County
 Date: August 25, 1967

Collector: G. M. Buxton
 Host: Persimmon
 Diagnosis: Sphaerulariid nematode.

2

Locality: California, Fresno, Fresno County
 Date: January 18, 1967
 Collector: Laboratory culture
 Host: Figs
 Diagnosis: Haplosporidian in Malpighian tubes;
Helicosporidium parasiticum; *Nosema* sp.
 (ovoid); sphaerulariid nematode.

3

Locality: Florida, Gainesville, Alachua County
 Date: September 15, 1967
 Collector: G. M. Buxton and D. Habeck
 Host: Squash
 Diagnosis: Cephaline eugregarine; haplosporidian in
 Malpighian tubes; sphaerulariid nematode.

4

Locality: Georgia, Tifton, Tift County
 Date: June 26, 1968
 Collector: J. A. Payne
 Host: Unknown
 Diagnosis: *Helicosporidium parasiticum*; sphaerulariid
 nematode.

5

Locality: Georgia, Tifton, Tift County
 Date: May 25, 1969
 Collector: J. A. Payne
 Host: Apple
 Diagnosis: Haplosporidian in Malpighian tubes.

6

Locality: Hawaii, Pahoa, Hawaii County
 Date: May 17, 1968
 Collector: G. T. Okumura
 Host: Papaya
 Diagnosis: No pathogens found.

7

Locality: Mississippi, Starkville, Oktibbeha County
 Date: August, 1967
 Collector: G. M. Buxton
 Host: Unknown
 Diagnosis: No pathogens found.

8

Locality: Nevada, Las Vegas, Clark County
 Date: October 4, 1968

Collector: R. C. Bechtel and D. F. Zoller
Host: Raisins
Diagnosis: Cephaline eugregarine

9

Locality: Texas, College Station, Brazos County
Date: August 15, 1968
Collector: G. M. Buxton
Host: Figs
Diagnosis: Cephaline eugregarine; haplosporidian in Malpighian tubes.

10

Locality: Vera Cruz, Tuxpan, Mexico
Date: October 30, 1967
Collector: G. T. Okumura
Host: Unknown
Diagnosis: Cephaline eugregarine.

Carpophilus fumatus Boheman

1

Locality: Florida, Gainesville, Alachua County
Date: September 14, 1967
Collector: G. M. Buxton and F. W. Mead
Host: Tomato
Diagnosis: No pathogens found.

Carpophilus hemipterus (Linnaeus)

1

Locality: California, Fresno, Fresno County
Date: July 21, 1966, August 5, 1966, and November 30, 1966
Collector: Laboratory culture
Host: Figs
Diagnosis: *Mattesia* sp. (possible *M. grandis*); *Nosema* sp. (ovoid); *Ophryocystis* sp.

2

Locality: Georgia, Tifton, Tift County
Date: May 25, 1969, and October 20, 1971
Collector: J. A. Payne
Host: Raisins
Diagnosis: *Helicosporidium parasiticum*; *Ophryocystis* sp.; sphaerulariid nematode.

3

Locality: Indiana, Bluffton, Wells County
Date: August 20, 1967
Collector: R. F. Wilkey
Host: Melon
Diagnosis: *Helicosporidium parasiticum*; *Ophryocystis* sp.

4

Locality: Texas, Calvert, Robertson County

Date: August 23, 1968
Collector: G. M. Buxton
Host: Peaches, figs
Diagnosis: Cephaline eugregarine; *Ophryocystis* sp.

5

Locality: Texas, College Station, Brazos County
Date: August 15, 1968
Collector: G. M. Buxton
Host: Peaches, watermelon
Diagnosis: Cephaline eugregarine; sphaerulariid nematode.

6

Locality: Texas, Bryan, Brazos County
Date: August 23, 1968
Collector: G. M. Buxton
Host: Peaches
Diagnosis: *Ophryocystis* sp.

Carpophilus lugubris Murray

1

Locality: California, Watts Valley, Fresno County
Date: October 4, 1968
Collector: J. Counsilman
Host: Raisins
Diagnosis: No pathogens found.

2

Locality: Illinois, Decatur, Macon County
Date: August 27, 1968
Collector: W. G. Goodman
Host: Mulberry tree
Diagnosis: No pathogens found.

3

Locality: Indiana, Bluffton, Wells County
Date: August 22, 1967
Collector: R. F. Wilkey
Host: Smut cluster on corn stem
Diagnosis: *Nosema* sp. (pyriform).

4

Locality: Indiana, Vincennes, Knox County
Date: May 23, 1968
Collector: T. Mouzin
Host: Raisins
Diagnosis: *Nosema* sp. (pyriform).

5

Locality: Maryland, Clarksville, Howard County
Date: September 19, 1968
Collector: R. F. Wilkey
Host: Rotten apples
Diagnosis: *Nosema* sp. (pyriform).

6

Locality: Maryland, Hancock, Washington County

Date: September 24, 1968
Collector: R. F. Wilkey
Host: Apples
Diagnosis: *Nosema* sp. (pyriform); *Ophryocystis* sp.

7

Locality: Mississippi, Starkville, Oktibbeha County
Date: September 26, 1967
Collector: G. M. Buxton
Host: Tomato
Diagnosis: Cephaline eugregarine; *Nosema* sp. (pyriform).

8

Locality: Texas, Bryan, Brazos County
Date: August 23, 1968
Collector: G. M. Buxton
Host: Peaches
Diagnosis: No pathogens found.

Carpophilus marginellus Motschulsky

1

Locality: California, Fresno, Fresno County
Date: September 15, 1966
Collector: Laboratory culture
Host: Figs
Diagnosis: *Nosema* sp. (ovoid).

2

Locality: California, Sacramento, Sacramento County
Date: May 13, 1970
Collector: I. E. Savage
Host: Raisins
Diagnosis: Cephaline eugregarine.

3

Locality: Hawaii, Pahoa, Hawaii County
Date: May 10, 1968
Collector: G. T. Okumura
Host: Papaya
Diagnosis: No pathogens found.

Carpophilus mutilatus Erichson

1

Locality: Alabama, Auburn, Lee County
Date: September 25, 1967
Collector: G. M. Buxton
Host: Apples
Diagnosis: Cephaline eugregarine; *Helcosporidium parasiticum*; *Howardula* sp.; *Ophryocystis* sp.

2

Locality: California, Brawley, Imperial County
Date: June 3, 1968

Collector: R. A. Flock
Host: Fruit and flowers
Diagnosis: *Ophryocystis* sp.

3

Locality: California, Fresno, Fresno County
Date: January 18, 1967, and February 18, 1971
Collector: Laboratory culture
Host: Figs
Diagnosis: *Howardula* sp.; *Mattesia* sp.; *Nosema* sp. (ovoid); *Nosema* sp. (pyriform); *Ophryocystis* sp.; *Pleistophora* sp.

4

Locality: California, Oildale, Kern County
Date: March 21, 1968
Collector: G. M. Buxton and M. Moody
Host: Orange
Diagnosis: Haplosporidian in Malpighian tubes; *Helcosporidium parasiticum*; *Ophryocystis* sp.; *Pleistophora* sp.

5

Locality: California, Santa Barbara, Santa Barbara County
Date: April 4, 1969
Collector: E. L. Paddock
Host: Raisins
Diagnosis: No pathogens found.

6

Locality: Georgia, Tifton, Tift County
Date: June 26, 1968
Collector: J. A. Payne
Host: Unknown
Diagnosis: *Howardula* sp.

7

Locality: Guerrero, Acapulco de Juarez, Mexico
Date: October 27, 1967
Collector: G. T. Okumura
Host: Coconut
Diagnosis: *Adelina* sp., *Nosema* sp. (pyriform).

8

Locality: Hawaii, Kona, Hawaii County
Date: May 18, 1968
Collector: G. T. Okumura
Host: Papaya
Diagnosis: No pathogens found.

9

Locality: Hawaii, Nanakuli, Honolulu County
Date: May 8, 1968
Collector: G. T. Okumura
Host: Cantaloupe
Diagnosis: *Helcosporidium parasiticum*; *Ophryocystis* sp.

Locality: Mexico, Cuernavaca, Mexico
 Date: October 27, 1967
 Collector: G. T. Okumura
 Host: Pineapple, grapefruit, guava
 Diagnosis: *Helicosporidium parasiticum*; *Nosema* sp. (pyriform); *Ophryocystis* sp.

Locality: Mississippi, Stoneville, Washington County
 Date: September 28, 1967
 Collector: G. M. Buxton
 Host: Pear
 Diagnosis: *Helicosporidium parasiticum*; *Howardula* sp.; *Ophryocystis* sp.

Locality: Nuevo Leon, Melchor Ocampo, Mexico
 Date: November 6, 1967
 Collector: G. T. Okumura
 Host: Citrus
 Diagnosis: *Howardula* sp.; *Nosema* sp. (reniform); *Pleistophora* sp.

Locality: Texas, Bryan, Brazos County
 Date: August 15, 1968, and August 23, 1968
 Collector: G. M. Buxton
 Host: Figs
 Diagnosis: Cephaline eugregarine; *Howardula* sp.

Locality: Texas, Calvert, Robertson County
 Date: August 23, 1968
 Collector: G. M. Buxton
 Host: Figs
 Diagnosis: *Howardula* sp.

Locality: Texas, College Station, Brazos County
 Date: August 15, 1968, and August 23, 1968
 Collector: G. M. Buxton
 Host: Pears, peaches, watermelon, figs, and crabapple
 Diagnosis: Cephaline eugregarine; *Crithidia* sp.; entaphelenchid nematode; haplosporidian in Malpighian tubes; *Helicosporidium parasiticum*; *Howardula* sp.; *Ophryocystis* sp.

Locality: Texas, Greenfield, Johnson County
 Date: August 26, 1968
 Collector: G. M. Buxton
 Host: Persimmon
 Diagnosis: *Howardula* sp.; *Nosema* sp. (ovoid); *Ophryocystis* sp.

Locality: Vera Cruz, Coatepec, Mexico
 Date: November 6, 1967
 Collector: G. T. Okumura
 Host: Orange
 Diagnosis: No pathogens found.

Locality: Vera Cruz, Fortin de las Flores, Mexico
 Date: October 30, 1967
 Collector: G. T. Okumura
 Host: Unknown
 Diagnosis: *Nosema* sp. (pyriform).

Carpophilus obsoletus Erichson

Locality: California, Clovis, Fresno County
 Date: April 30, 1968, and July 17, 1968
 Collector: Laboratory culture
 Host: Figs
 Diagnosis: Cephaline eugregarine; *Nosema* sp. (pyriform); *Pleistophora* sp.

Carpophilus pilosellus Motschulsky

Locality: Florida, Gainesville, Alachua County
 Date: October 26, 1968
 Collector: G. M. Buxton
 Host: Squirrel cage debris
 Diagnosis: Haplosporidian in Malpighian tubes; *Helicosporidium parasiticum*.

Conotelus stenoides Murray

Locality: Georgia, Tifton, Tift County
 Date: September 12, 1968
 Collector: J. A. Payne
 Host: Palm fruit
 Diagnosis: Cephaline eugregarine; *Helicosporidium parasiticum*.

Conotelus sp.

Locality: Texas, Greenfield, Johnson County
 Date: August 26, 1968
 Collector: G. M. Buxton
 Host: Peaches
 Diagnosis: *Mattesia* sp.

Haptoncus luteolus (Erichson)

Locality: California, Fresno, Fresno County

Date: January 18, 1967
Collector: Laboratory culture
Host: Pears
Diagnosis: *Nosema* sp. (ovoid).

2

Locality: Texas, Bryan, Brazos County
Date: August 23, 1968
Collector: G. M. Buxton
Host: Pears
Diagnosis: Cephaline eugregarine.

3

Locality: Texas, College Station, Brazos County
Date: August 14, 1968
Collector: G. M. Buxton
Host: Watermelon
Diagnosis: Haplosporidian in Malpighian tubes.

4

Locality: Texas, Greenfield, Johnson County
Date: August 26, 1968
Collector: G. M. Buxton
Host: Persimmons
Diagnosis: No pathogens found.

Lobiopa insularis (Castelnau)

1

Locality: Georgia, Tifton, Tift County
Date: May 25, 1969
Collector: J. A. Payne
Host: Apple
Diagnosis: No pathogens found.

2

Locality: Texas, Calvert, Robertson County
Date: August 21, 1968
Collector: G. M. Buxton
Host: Figs
Diagnosis: *Leptomonas* sp.; *Mattesia* sp.

3

Locality: Texas, College Station, Brazos County
Date: August 14, 1968
Collector: G. M. Buxton
Host: Figs
Diagnosis: Cephaline eugregarine.

4

Locality: Texas, Greenfield, Johnson County
Date: August 26, 1968
Collector: G. M. Buxton
Host: Pears
Diagnosis: Cephaline eugregarine.

5

Locality: Texas, Weslaco, Hidalgo County
Date: August 19, 1968
Collector: G. M. Buxton
Host: Grapefruit
Diagnosis: Cephaline eugregarine; *Leptomonas* sp.

Stelidota geminata (Say)

1

Locality: California, Piedra, Fresno County
Date: October 4, 1968
Collector: J. Counsilman
Host: Raisins
Diagnosis: No pathogens found.

2

Locality: Mississippi, Stoneville, Washington County
Date: September 28, 1967
Collector: G. M. Buxton
Host: Persimmon
Diagnosis: *Nosema* sp. (ovoid).

3

Locality: Texas, Laredo, Webb County
Date: August 20, 1968
Collector: G. M. Buxton
Host: Grapefruit
Diagnosis: *Helicosporidium parasiticum*; *Ophryocystis* sp.

Stelidota sp.

1

Locality: Texas, Roma, Starr County
Date: August 18, 1968
Collector: G. M. Buxton
Host: Grapefruit
Diagnosis: Cephaline eugregarine; *Helicosporidium parasiticum*.

Urophorus humeralis (Fabricius)

1

Locality: California, Fresno, Fresno County
Date: August 21, 1966
Collector: Laboratory culture
Host: Figs
Diagnosis: *Mattesia* sp.

2

Locality: California, Sacramento, Sacramento County
Date: September 6, 1967

Collector: R. F. Wilkey
Host: Melon
Diagnosis: Cephaline eugregarine.

8

3

Locality: Guerrero, Acapulco de Juarez, Mexico
Date: October 27, 1967
Collector: G. T. Okumura
Host: Coconut
Diagnosis: No pathogens found.

4

Locality: Guerrero, Barrio Pie de la Cuesta, Mexico
Date: October 30, 1967
Collector: G. T. Okumura
Host: Banana
Diagnosis: *Helicosporidium parasiticum*.

5

Locality: Hawaii, Pahoa, Hawaii County
Date: May 17, 1968
Collector: G. T. Okumura
Host: Papaya
Diagnosis: Sphaerulariid nematode.

6

Locality: Hawaii, Nanakuli, Honolulu County
Date: May 8, 1968
Collector: G. T. Okumura
Host: Cantaloupe
Diagnosis: No pathogens found.

7

Locality: Texas, Roma, Starr County
Date: August 20, 1968
Collector: G. M. Buxton
Host: Grapefruit
Diagnosis: No pathogens found.

Locality: Texas, Weslaco, Hidalgo County
Date: August 20, 1968
Collector: G. M. Buxton
Host: Guava
Diagnosis: Diplococcoid bacterium.

Steinhaus and Marsh³ reported two fungi, *Beauveria bassiana* (Bals.) and an *Aspergillus* sp., from the nitidulid *Glischrochilus quadrisignatus* (Say); however, fungi were not observed in the live adult beetles that were examined. The authors found only one bacterium and no viruses; however, protozoa were predominant and occurred in all but one of the host species (table 1). Nematodes were found in one-third of the nitidulid species samples, and, with the exception of one entaphelenchid, they all belonged to the family Sphaerulariidae.

Four pathogens—a host specific sphaerulariid nematode (*Howardula* sp.) and three nonspecific sporozoans (*Helicosporidium parasiticum*, *Pleistophora* sp., and a pyriform *Nosema* sp.)—are being studied for their biological control potential on stored-product insects.

³Steinhaus, Edward A., and Marsh, Gordon A. Reports of Diagnoses of Diseased Insects, 1951–1961. Hilgardia 33(9):387. 1962

TABLE I.—Frequency of pathogen occurrence

Pathogens found	Nitidulid species infected		Nitidulid accessions infected	
	Number	Percent ¹	Number	Percent ²
Protozoa	14	93.3	79	66.9
Kinetoplasida	2	13.3	3	2.5
Eugregarinida	13	86.7	27	22.9
Neogregarinida	8	53.3	38	32.2
Eucoccida	1	6.7	1	.8
Haplosporida	4	26.7	9	7.6
Helicosporida	8	53.3	23	19.5
Microsporida	9	60.0	21	17.8
Nematoda (Tylenchida)	5	33.3	25	21.2
Total number infected	14	93.3	90	76.3

¹Of 15 nitidulid species.

²118 accessions of nitidulid beetles were examined.

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